

Code No: R41082

R10

Set No. 1

IV B.Tech I Semester Supplementary Examinations, October/November - 2017

PLANT DESIGN FOR CHEMICAL ENGINEERS

(Chemical Engineering)

Time: 3 hours

Max. Marks: 75

Answer any FIVE Questions
All Questions carry equal marks

- 1 a) Discuss in detail the fire and explosion hazards. [8]
b) Explain the plant operation and control. [7]
- 2 a) How do you carry out literature survey and patent search? Explain. [8]
b) Draw the flow diagram illustrating hierarchial process-flow sheet synthesis development, evaluation, selection. [7]
- 3 a) List out the process simulation guidelines. [7]
b) Discuss in detail about presentation of results. [8]
- 4 a) An available crusher has been accepting hard rock with a volume –surface mean diameter of 0.069 m and providing a product with a volume-surface mean diameter of 5×10^{-3} m. The power required for crushing 10000 kg/h of this specific rock is 6.35kW. what would be the power consumption if the capacity were reduced 9000 kg/h with the same feed characteristics but with a reduction in the volume surface mean diameter of the product to 4×10^{-3} m. Assume that the mechanical efficiency of the unit will remain unchanged. [8]
b) A two stage steam jet is to be used on a large vacuum system. It is estimated that 10 kg of air must be removed from the system each hour..The vapors being removed will contain water vapor at a pressure equivalent to the equilibrium vapor pressure of water at 15°C . If a suction pressure of 50 mmHg absolute is to be maintained by steam jet, estimate the kg of stem per hour that will be required to operate the jet. [7]
- 5 a) A saturated organic fluid with a latent heat of vaporization of 200 kJ/kg and a flow rate of 2 kg/s is to be vaporized at a constant saturation temperature of 90°C .the hot fluid used to vaporize the organic fluid enters the evaporator at a temperature of 200°C and leaves at a temperature of 120°C .the heat capacity of the hot fluid may be assumed to remain constant at 2.2kJ/kg K over the specified temperature range. If the average overall heat transfer coefficient is $400 \text{ W/m}^2 \text{ K}$, determine the required flow rate of the hot fluid ,the value of ΔT_m , and the heat transfer area required. [8]
b) List out the criteria for the preliminary selection of the appropriate heat exchanger type. [7]

- 6 a) A slurry containing 1 kg of filterable solids per 10 kg of liquid is being filtered with a plate and frame filter press having a total filtering area of 25m^2 . This unit provides 5000 kg of filtrate during the first 2 h of filtration, starting with a clean unit and maintaining a constant pressure drop of 67 kPa. The resistance of the filter medium is negligible. The time required for washing and filtrate removal is 3 h per cycle. The unit is always operated with a constant pressure drop. The filter press is to be replaced by a rotary vacuum drum filter with negligible filter medium resistance. This rotary filter can deliver the filtrate at a rate of 500 kg/h when the drum speed is 0.3 r/min. Assuming the fraction submerged and the pressure unchanged, What drum speed is necessary to produce the amount of filtrate delivered in 24 h from the rotary filter match to the amount of filtrate obtained per 24h from the plate and filter? [8]
- b) Write notes on absorption and humidification. [7]
- 7 a) Present the reaction design and evaluation scheme flowchart. [7]
- b) Dilute propylene oxide is to be catalytically hydrolyzed to propylene glycol in an adiabatic PFR according to the kinetics $-r_{\text{propylene oxide}} = kc_{\text{propylene oxide}}$ $k = 4.71 * 10^9 \exp\left(\frac{-63,010}{RT}\right) \text{s}^{-1}$. where R is in kJ/kg mol.K. The reaction is conducted isothermally at 300 K. The feed consists of a 10 weight percent aqueous stream of propylene oxide at 300 K with a flow rate of $0.01 \text{ m}^3/\text{s}$. Water stream containing 0.1 weight percent aqueous sulfuric acid (the catalyst) is added at a flow rate of $0.01 \text{ m}^3/\text{s}$. Size the reactor to achieve 90% conversion. [8]
- 8 a) Heat exchanger 'A' cost Rs. 7.5 lakhs with AOC of Rs. 0.5 lakhs. Heat Exchanger 'B' costs Rs. 10.0 lakhs with AOC of 0.3 lakhs. Salvage value of A & B heat exchangers are Rs 8000 and Rs 12000 respectively. If service life both Heat exchangers is 5 years and interest rate is 12 %. What is the present worth for 10 years service rendered by both the alternatives. [8]
- b) Write short notes on cost correlations of pressure vessels. [7]